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ACTIVITY OF TsNIITMASh IN FIELD OF METALS CONSERVATION

/The following is taken from an article by A. Korolev, Deputy Director of TsNIITMASh (Central Scientific Research Institute of Technology and Machine Building of the Ministry of Heavy Machine Building), Stalin Prize Laureate, and Candidate of Technical Sciences, and N. Kuznetsov, Deputy Division Chief of TsNIITMASh, written in response to a request made by the editors of the periodical Za Ekonomiyu Materialov (For the Conservation of Materials).

The request was sent to a number of scientific research institutes for the purpose of obtaining information on their plans for activity in the field of the conservation of material resources in 1953./

Efforts in the designing and production of more economical types and profiles of rolled stock are among the most essential works conducted by TsNIITMASh in the field of metal conservation. Such profiles include, in particular, wide-flanged beams whose depth goes to 1,000 mm with 400 mm-wide flanges, while ordinary I-beams have 600 mm maximum depth and flanges not more than 180 mm wide. The moments of resistance and inertia are considerably increased in wide-flange beams because of their depth and the concentration of a relatively large mass of metal in the flanges. Substitution of these beams for ordinary beams reduces metal consumption by 20-22%.

All major research works for establishing the design parameters of a mill for rolling wide-flange beams have been conducted on an experimental rolling mill especially designed for this purpose. Data thus obtained were conveyed to appropriate plants for their industrial utilization.

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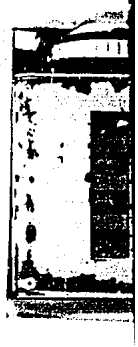


Certain mills for rolling special profiles radically change the technology of machine-building plants. Thus, the rolling of periodic shapes, used successfully in the machine-building industry, is of great interest for the national economy. The application of periodic-profile rolled stock provides a considerable saving of metal, sometimes up to 20%, owing to the increased precision of blanks and, as a result, reduced allowances for machining.

A work of great importance was fulfilled at the Central Design Bureau of Metallurgical Machine Building under the supervision of Professor A. I. Tselikov on developing the cross-helical method of rolling parts of circular cross section. For such parts, cross rolling on three-high mills, substituting entirely for stamping, increases the yield of sound product from 0.70-0.75 to 0.80-0.85 and, in addition, considerably reduces losses of metal in chips.

Experimental works on the development of three-high mills have resulted in the design of mills of three types -- 70, 120, and 250 -- the application of which would give the following savings in metal annually: 1,400 t for mill 70 in rolling axle shafts, nearly 5,000 t for mill 120 used for rolling large periodic shapes, and up to 20,000 t in rolling railroad-car axles by mill 250. At present, the model 70 mill, built at the experimental shop of the institute, has been released for industrial exploitation.

In addition to this mill, an experimental mill for rolling bearing balls was built at TsNIITMASh and delivered to one of the plants of the ball-bearing industry. This mill, small and simple in design, provides for a sharp increase in productive capacity with a high quality level of products; and it completely replaces the stamping presses used in the fabrication of balls larger than 1 inch in diameter, and the lathes for turning balls of diameters from 1 7/16 to 1 5/8 inches. Under full operating load, the mill makes possible the saving of up to 4,800 t of metal per year.

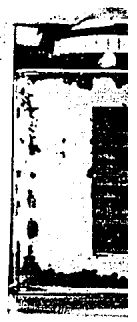
There are a number of rolling mills which are still in the design stage, such as mills for rolling torsion shafts, bodies of rotation, conical pipes of large diameters, balls for grinding mills, hollow pieces, etc. The conservation of metal in rolling such products will amount to 10 to 50%.

Besides the application of new economical profiles of rolled stock, an increase in the precision of rolling standard profiles is very important. To obtain rolled products with minus allowances, it is necessary to improve the operating precision of existing mills. For this purpose, the laboratories of the institute are studying methods for the determination of metal pressure on rolls and frame rigidity of mills at various metallurgical plants.

Considerable work was conducted by the institute improving the physicomechanical properties of cast iron as a material for replacing steel in the fabrication of various machine parts.

High-strength cast iron with spheroidal graphite in the cast structure represents a new material which combines a number of the technological and exploitation properties of cast iron with the high strength peculiar to steel, and has sufficiently high indexes of plastic properties.

In addition, investigations of corrosion resistance corroborate the possibility of substituting cast iron for steel castings working under conditions of corrosion. The manufacture of cast iron requires no scarce or expensive additions and, as practice has shown, is within the reach of any foundry shop. At present, a number of plants have already established the production of high-strength cast iron and use it for a large quantity of castings, with considerable economical effect. For example, the fabrication of crankshafts cast out of high-strength iron for the 6DR 30/50 engine, instead of forged steel



crankshafts, permitted a saving of about 7 t of metal per shaft. The use of high-strength cast iron for castings of large parts, weighing from 0.5 to 6 t, reduces metal consumption by 15-20% as compared with steel castings.

For the purpose of replacing steel with high-strength cast iron and decreasing the weight of parts, designers and laboratories of metallurgical machine building are studying local stresses on the models of rolling mill stands and gear housings and developing methods for the design of these parts with consideration of fatigue characteristics; for the same purpose they are also establishing effective loads and local stresses in the parts of rolling mills. Completion of these works will permit a still wider application of high-strength cast iron in production, thus releasing a considerable amount of steel.

Taking into consideration the importance of improvement in operational qualities of the changeable rolls of rolling mills, the institute is conducting a number of works investigating the various technological processes involved in the fabrication of rolls, which requires a large amount of high-alloy steel whose machining is quite complicated and labor consuming.

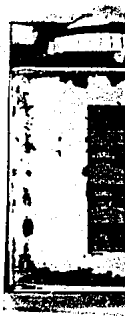
Considerable progress was made in increasing the wear resistance and durability of rolls. Improvements in methods of heat treatment and the solving of some problems related to the structure and composition of metal permitted a considerable reduction in the rejection rate at the plants fabricating rolls for rolling mills. New methods were studied for rapid heating of rolls during heat treatment.

For improving the quality of the surface layer, the institute developed the technology of induction heating with industrial-frequency currents, constructing for this new process special heat-treating stands which make possible a gradual heating of the surface of rolls for cold-rolling mills up to 350 mm in diameter and up to 1,000 mm long. Such installations are now in operation at one of the plants of the Ministry of Heavy Machine Building, and a large lot of rolls, heat treated by this method, is under production testing at various plants. To improve the operational qualities of rolls, the institute suggested the replacement of grinding by other methods of abrasive finishing, which secure higher fineness of surface and increase certain strength characteristics of the surface layer of rolls. These methods are already in use at the Serp i Molot plant.

Design and production technology of large sliding friction bearings represent one of the essential works conducted by TsNIITMASh. Babbitt pouring into insert bearing shells is a very important operation in the process of fabricating large bearings. A sound bond of inserts with babbitt, with considerably decreased consumption of babbitt, has been achieved with the aid of the centrifugal casting machine designed at the institute.

Upon the completion of research works in designing large bearings, their mass production was arranged at one of the plants producing bearings for new rolling mills and for those already in operation.

A number of scientific-research and experimental works, conducted by TsNIITMASh, deal with the problem of reducing the weight of machines. Recent methods of studying and measuring the stresses to which machine parts are subjected in operation are of great importance for correct determination of the weight parameters of machines. This was conclusively corroborated by experimental investigations conducted in the laboratories of TsNIITMASh with the aid of tensometers used under static and dynamic conditions. These investigations are especially important with regard to parts of intricate shape, where theoretical calculations do not always give correct solutions.



Wide utilization of these methods has permitted realization of some measures which led to a considerable reduction in the weight of machines. For example, a new layout of a mill for cold rolling of pipes, according to which a pipe is rolled with small rolls instead of large ones of complicated fabrication, permitted reducing the weight of a roll stand from 1,600 to 400 kg, simultaneously increasing the stiffness of the rolling mill.

In developing a standard mill for razor strip rolling, a new design of 12-roll mill was adopted, permitting a reduction of the pressure on rolls by 30-40%. Because of this reduction, the weight of the roll stand was decreased, in comparison with a four-high mill of the same duty, and the use of smaller-diameter rolls made it possible to lower the weight of the main reducer from 1.6 to 0.4 t. At present several such rolling mills are in operation at Soviet plants.

The weight of rolling equipment may be decreased also by rational location of supports, bringing them as close as possible to the zone of a load acting on a roll. Thus, changes in the arrangement of bearings in the combined reducer for four-high mill 1700 permitted decreasing the weight of the reducer by 31%, from 55 to 38 t, without impairing its operating qualities.

Increase in the wear resistance of machine parts, and in many cases a decrease in their weight, may be achieved by application of such methods of surface treatment as shot peening, induction hardening, surface rolling, carburizing, and nitriding.

The effectiveness of these treatments, especially in respect to increasing the strength of parts subjected to repeated stressing, has been generally recognized. Therefore, the scientific workers of TsNIITMASh are continuing their efforts to expand the application field of surface-treating technology. They conduct full-scale fatigue tests of crankshafts made of high-strength cast iron and study surface strengthening of cast iron in connection with the general problem of replacing steel with high-strength cast iron. At the same time, they are continuing investigations connected with development of the theoretical fundamentals of strengthening technology, studying the physical properties of a strengthened layer.

Numerous research works in the field of reducing machine weight were aimed at developing methods for the selection of allowable stresses in various parts and assemblies of machines. The results made it possible to recommend the allowable stresses for such responsible parts as the rolls of rolling mills and permitted a proper analysis of existing machine designs.

Thus, investigations on the stiffness of the roll stands of sheet mills revealed that the deformations of frame members amount to only 10% of the summary deformation of all parts combined with the frame, such as operating and supporting rolls, bearings, cradles, adjusting screws, etc., and that normal stresses in the most stressed points of the frame do not exceed 250-400 kg/sq cm, not considering local stresses. In this way, it has been established that uprights and crosspieces of the frame may be lightened without decreasing its stiffness. For example, upon increasing the allowable stress for the frame by 50%, the deformation of the opening, in respect to the summary deformation of parts, would increase only from 10 to 15%. This shows that the weight of the stand of rolling mills may be considerably decreased.

There are serious shortcomings in the field of practical realization of completed scientific-research and experimental works, mainly because ministries have no general control over industrial adaptation of the achievements of their scientific-research institutes. At present, all institutes of ministries, including TsNIITMASh, usually promote their works into production by means of

agreements with separate plants or by orders which they attempt to get from high officials in each individual case. Such conditions considerably delay the introduction of new machines and technological processes into industry.

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